

WHAT IS CLAIMED IS:

1. A plasma processing apparatus comprising:
  - a vacuum chamber that accommodates an object
  - 5 to be processed, and provides a plasma process to the object in a vacuum or reduced pressure environment;
  - a dielectric for transmitting microwaves to said vacuum chamber and for maintaining the vacuum or reduced environment of the vacuum chamber;
- 10 a plate that has slots for guiding the microwaves to the dielectric; and
  - a temperature control mechanism that has a cooling channel between said plate and said dielectric, and controls temperature of the dielectric.
- 15 2. A plasma processing apparatus according to claim 1, wherein an interval between said plate that forms the cooling channel and said dielectric is equal to or smaller than 2 mm.
- 20 3. A plasma processing apparatus according to claim 1, wherein the cooling channel is supplied with coolant.
- 25 4. A plasma processing apparatus according to claim 3, wherein the coolant includes at least one of

air, nitrogen, inactive gas, Fluorinert®, Galden® and fluorine included solution.

5. A plasma processing apparatus according to  
5 claim 3, wherein the coolant includes gas, liquid or a  
low dielectric loss material.

6. A plasma processing apparatus according to  
claim 1, wherein the cooling channel is exhaustibly  
10 supplied with coolant.

7. A plasma processing apparatus according to  
claim 1, further comprising:

a temperature detector for measuring the  
15 temperature of or near said dielectric; and  
a controller for controlling a flow rate of  
coolant based on the temperature detected by said  
temperature detector, the coolant being supplied to the  
cooling channel.

20

8. A plasma processing apparatus according to  
claim 1, wherein the cooling channel arranges a heat  
conductive medium.

25 9. A plasma processing apparatus according to  
claim 8, wherein the heat conductive medium is arranged  
around said dielectric.

10. A plasma processing apparatus according to  
claim 8, wherein the heat conductive medium includes  
silicon powder or silicon oil.

5        11. A plasma processing apparatus according to  
claim 8, wherein the heat conductive medium is a high  
dielectric loss material.

10       12. A plasma processing apparatus according to  
claim 1, wherein said plate is made of a material that  
includes at least one of aluminum, gold, silver and  
copper.

15       13. A plasma processing apparatus according to  
claim 1, wherein said dielectric is made of a material  
that includes at least one of alumina-ceramic, aluminum  
nitride and quartz.

20       14. A plasma processing apparatus according to  
claim 3, further comprising:

25       a waveguide for guiding the microwaves to the  
plate, said waveguide forming plural holes in place  
which allow the coolant to pass through the holes and  
prevent the microwaves from transmitting through the  
holes; and

      a partition, formed on said waveguide between  
the place of said waveguide and a microwave source for

supplying the microwaves, for preventing the coolant from moving along said waveguide to the microwave source.

5        15. A plasma processing apparatus according to claim 3, wherein said partition is made of a high dielectric loss material.

10      16. A plasma process method for plasma-processing an object to be processed which is accommodated in a vacuum chamber in a vacuum or reduced pressure environment, said method comprising the steps of:

15      detecting temperature near a dielectric that maintains the vacuum or reduced pressure environment of the vacuum chamber as well as transmitting microwaves to the vacuum chamber; and

20      controlling a flow rate of coolant in a cooling channel arranged between the dielectric and a plate having slots that guide the microwaves into the dielectric, based on a detection result by said detecting step.